

REMARKS

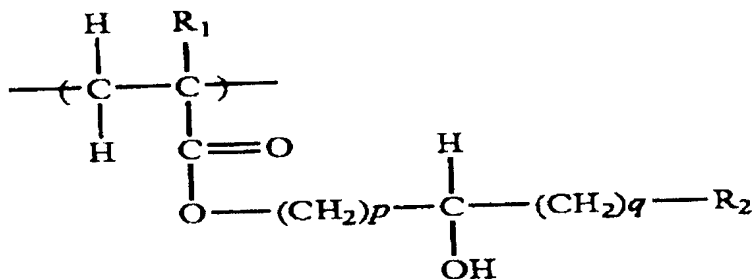
Claims 1, 2 and 4-10 are pending in this application. In view of the following remarks, reconsideration and allowance are respectfully requested.

I. Rejections Under 35 U.S.C. §103**A. Takei**

The Office Action rejects claims 1, 2, 4-6 and 8-10 under 35 U.S.C. §103(a) over WO 02/05035 to Takei et al. ("Takei") (citations from English equivalent, U.S. Patent Application Publication No. 2003/0146416). Applicants respectfully traverse the rejection.

Claim 1 is directed to, *inter alia*, a gap fill material for filling a hole in a substrate having an aspect ratio shown in the height/diameter of 1 or more, wherein the composition comprises a polymer having a weight average molecular weight of 5,000 to 20,000 that is composed of only structural units of formula (1)

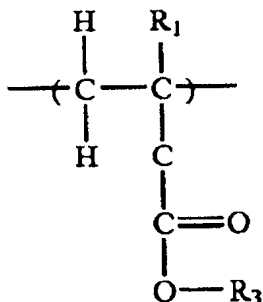
(1)



and containing components having molecular weight of 3,000 or less in a rate of 20% or less.

Claim 2 recites similar features and additionally recites that the polymer may be composed of structural units of formula (1) above and formula (2)

(2)



Applicants respectfully assert that Takei would not have rendered obvious each and every feature of at least claims 1 and 2.

The Office Action acknowledges, on page 4, that Takei does not disclose a polymer comprising only units derived from the hydroxyalkyl (meth)acrylates and having a weight average molecular weight in the range of 5,000 to 20,000. However, the Office Action asserts that it would have been obvious to one of ordinary skill in the art to have obtained the claimed polymers based on Takei's disclosure that polymers comprising at least one hydroxyl group per repeating unit may be obtained by polymerizing hydroxyalkyl (meth)acrylate. The Office Action further asserts that Synthetic Examples 2 and 3 of Takei disclose polymers having weight average molecular weights of 5,300 and 19,000, respectively, and, thus, the Office Action asserts that one of ordinary skill in the art "would have been motivated to obtain polymers with weight average molecular weights in this range." Applicants respectfully disagree.

To raise the removal rate by dry etching, it is preferable to reduce the aromatic ring structures contained in the gap fill material forming composition. Particularly, it is preferable to reduce the amount of aromatic ring structures contained in the polymer component. Therefore, when a gap fill material layer with a high dry-etching removal rate is desired, a polymer having no aromatic ring structures is preferably used. See specification, paragraph [0052]. When the polymer has a large weight average molecular weight, the gap fill material

forming composition will not adequately fill the inside of the hole, or may not provide sufficient flattening properties to the substrate. See specification, paragraph [0021]. However, the claimed gap fill material composed of the structural unit of formula (1) or composed of the structural units of formulae (1) and (2), that have a weight average molecular weight of 5,000 to 20,000, and wherein components that have a molecular weight of 3,000 or less are contained in a rate of 20% or less, as is recited in claims 1 and 2, provides excellent filling and flattening properties.

Support for the above assertions can be found, for example, in a comparison of Examples 1-5 and Comparative Example 1 in the specification. As is shown in Table 1 on page 23 of the specification, Comparative Example 1 is inferior in both film thickness bias and flattening rate percentage when compared to Examples 1-5. Examples 1-5 contain an acrylic polymer having a weight average molecular weight of 9,800-15,000, are composed of only the structure unit of formula (1) (Synthetic Example 1) or composed of the structural units of formulae (1) and (2) (Synthetic Examples 2 and 3), and having components with a molecular weight of 3,000 or less contained in a rate of 8-9%. However, Comparative Example 1 uses polyethelyene glycol manufactured by Junsei Chemical Co., Ltd., that has a weight average molecular weight of 2,000, which is below the minimum value of the range recited in claims 1 and 2. See specification, paragraph [0071]. Thus, the examples in the specification show that when an acrylic polymer having a weight average molecular weight below the minimum of the range recited in claims 1 and 2 is used as a component of the gap fill material, flattening properties and difference in film thickness become inferior.

Further, in Comparative Example 3 of Takei, a polyhydroxypropyl methacrylate having a weight average molecular weight of 130,000 was used. See Takei, paragraphs [0127] and [0147]. Although the polyhydroxypropyl methacrylate has a unit structure that corresponds to that of claims 1 and 2, the weight average molecular weight is above the

maximum value of the range recited in claims 1 and 2. As disclosed in Table 2, paragraph [0162], of Takei, Comparative Example 3 has a planarizing factor bias of 31 that is inferior to the flattening rate of the examples in the instant specification that were produced with polymers according to claims 1 and 2.¹ See specification, page 23, Table 1. Therefore, even the examples of Takei show that gap fill materials made of polymers of structural units of the claimed formulae (1) and (2), but that have a weight average molecular weight above the maximum value of the claimed range, have inferior properties when compared to gap fill materials made according to claims 1 and 2.

However, Takei does not disclose or provide any reason or rationale for one of ordinary skill in the art to have known that modifying the weight average molecular weights of the polymers in the gap fill material disclosed therein to be within the claimed range of 5,000 to 20,000 can or should provide improved thickness and flattening properties. Therefore, because the claimed weight average molecular weight provides excellent and unexpected results and because Takei does not disclose or provide any reason or rationale to have used the claimed weight average molecular weight, claims 1 and 2 would not have been rendered obvious by Takei.

Additionally, Takei discloses a composition for forming a gap-filling material containing a polymer solution that has a weight average molecular weight of 1,000 to 100,000, and preferably contains at least one or more hydroxyl compounds that are cross-linking functional groups. Takei exemplifies thermoplastic polymers that are obtained by polymerizing compounds having one addition-polymerization unsaturated bond in a molecule such as acrylic acids, hydroxyalkyl acrylates, hydroxyalkyl methacrylates, styrenes, celluloses, crotonic acids, thermosetting phenol resins, and the like. See Takei, paragraphs [0062]-

¹ Flattening rate in the specification is the same as planarizing factor in Takei. Compare paragraph [0074] of the specification with paragraphs [0153]-[0155] of Takei.

[0070]. Also, as preferable polymers, Takei discloses a polymer containing a repeating unit of general formula (1) (p-vinyl phenol structure) as an essential structure alone or in combination with, for example, a copolymer composed of a unit derived from hydroxystyrene of formula (5) or a unit derived from hydroxyethyl methacrylate of formula (6). See Takei, paragraphs [0083]-[0093]. In the examples, Takei utilizes a copolymer of p-vinyl phenol and styrene (Synthetic Example 1), a copolymer of p-vinyl phenol and methyl methacrylate (Synthetic Example 2) or commercially available polymer containing a p-vinyl phenol structure. See Takei, Examples 1-11, paragraphs [0131]-[0144].

However, Takei does not disclose and does not provide any reason or rationale for one of ordinary skill in the art to have selected the specifically claimed polymers over the preferred polymers disclosed therein. Put differently, Takei does not provide any disclosure that using the specifically claimed polymers would be beneficial or desirable. Therefore, it would not have been obvious to one of ordinary skill in the art to have selected the non-preferred polymers of Takei to yield the specifically claimed polymers, and to have subsequently limited their weight average molecular weights to be within the claimed range. Accordingly, claims 1 and 2 would not have been rendered obvious by Takei.

Claims 1 and 2 would not have been rendered obvious by Takei. Claims 4-6 and 8-10 depend from claim 1 and, thus, also would not have been rendered obvious by Takei. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

B. Takei and Rutter

The Office Action rejects claim 7 under 35 U.S.C. §103(a) over Takei in view of U.S. Patent Application Publication No. 2002/0110665 to Rutter et al. ("Rutter"). Applicants respectfully traverse the rejection.

For at least the reasons stated above, claim 1 would not have been rendered obvious by Takei. Further, the Office Action applies Rutter as disclosing an aperture film material

comprising a cross-linkable polymer with a hydroxyl group, one or more cross-linking agents, one or more acid catalysts, and a solvent and, thus, the Office Action does not apply the Rutter reference to address the above discrepancies of Takei as to claim 1. Therefore, Takei and Rutter, individually or in combination, would not have rendered obvious each and every feature of claim 1.

Claim 1 would not have been rendered obvious by Takei and Rutter, individually or in combination. Claim 7 depends from claim 1 and, thus, also would not have been rendered obvious by Takei and Rutter, individually or in combination. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

II. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of the application are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



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